Appendix B: Economic Assessment of the Proposed Aldo Leopold NWR

Return to Fairfield Marsh Conservation Partnership Environmental Assessment

Appendix B

ECONOMIC ASSESSMENT
OF
THE PROPOSED ALDO LEOPOLD
NATIONAL WILDLIFE REFUGE

Prepared for:

U.S. Fish and Wildlife Service
4401 N. Fairfax Drive
Arlington, VA 22203

Prepared by:

Robert E. Unsworth and Robert W. Paterson
Industrial Economics, Incorporated
2067 Massachusetts Avenue
Cambridge, MA 02140

Technical assistance provided by:

Dr. John R. Stoll, University of Wisconsin, Green Bay

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EXECUTIVE SUMMARY

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The U.S. Fish and Wildlife Service (FWS) has proposed development of the Aldo Leopold National Wildlife Refuge (ALNWR) in south-central Wisconsin. Implementation of this proposal would involve fee title acquisition, from willing sellers, of approximately 5,000 to 8,500 acres in two counties. The purpose of this paper is to assess the probable economic consequences of resultant changes in land use and management. The analysis reflects a comparison of current economic conditions with those anticipated to exist should various alternatives described in the proposal be implemented. Specifically, we estimate changes in regional economic activity and net social economic well-being arising from a shift from agricultural output to refuge-related activities.[1] In addition, the potential property tax implications of public ownership of lands described in the ALNWR proposal are considered. The results of these analyses are summarized below.

SUMMARY OF ECONOMIC IMPACTS

National Wildlife Refuges enhance the nation's stock of natural assets and provide significant benefits to its citizens. The magnitude of net social benefits provides a means to compare the value of alternative projects (such as the establishment of a new refuge) from a national perspective. However, the costs of these assets may be more concentrated among regional residents than are the benefits. Costs borne by regional citizens must be recognized, examined, and minimized to whatever extent feasible. As such, Economic Assessments examine not only social benefits, but also regional economic impacts.

The ALNWR would increase social economic well-being substantially by expanding and improving the quality of recreational opportunities in the area. Our analysis relies upon a benefits transfer methodology and statistical model of annual visitation to estimate the benefits of the new refuge. The results suggest that the refuge would add three to five million dollars to national economic well-being annually. Results of our analysis of social benefits are summarized in Exhibit ES-1.

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[1] The notion of social economic well-being refers to the branch of economics known as welfare economics, a means to evaluate the efficiency of public policy changes. This concept is discussed in detail in Chapters 3 and 4.

Exhibit ES-1		
Total Annual Estimated Economic Value for Recreational Opportunities on the ALNWR (1998$)		
Activity	**Lower Bound Estimate**	**Upper Bound Estimate**
Hunting	$205,000	$512,000
Fishing	$93,600	$224,000
Wildlife Viewing	$2,728,000	$4,365,000
Total:	**$3,027,000**	**$5,101,000**

The ALNWR may create additional social benefits that are not estimated in this analysis due to inadequate data. For example, restoration of wetland areas may decrease flooding in the area and improve water quality.

The proposed ALNWR would have three principal effects on the regional economy of Sauk and Columbia Counties: (1) increased spending in the area by visitors to the proposed refuge, (2) reduced agricultural production, (3) increased expenditures by the FWS to build and maintain refuge facilities. Due to the interdependent nature of businesses in a given area, initial changes in output and expenditures have proportionally larger total effects on regional economic performance. Thus, we rely upon appropriate input/output modeling techniques to estimate the magnitude of these changes. The results are summarized below.

- Our analysis suggests that full implementation of the refuge proposal in 20 years will result in a $1.24 to $1.48 million increase in regional output per year, 28 to 33 new jobs per year, and $343,000 to $408,000 in employee compensation per year attributable to refuge visitor spending and operating and maintenance expenditures by the FWS.[2]

- Changes in agricultural activity, once the refuge is complete, will result in a reduction in regional output of $3.19 to $4.36 million, 44 to 61 jobs and $525,000 to $691,000 in employee compensation annually.

- Thus, establishment of the ALNWR is likely to result in a net reduction in regional output of $1.7 to $3.1 million annually, depending on the development alternative pursued. This change is equivalent to four to seven *one-hundredths* of one percent of 1998 output in the region. In addition, when the refuge is complete, 11 to 33 jobs (two to five *one-hundredths* of one percent of 1998 employment) and $117,000 to $348,000 in employee compensation (one to three *one-hundredths* of one percent of 1998 salaries), which would have existed in agricultural industries, will not have been replaced by jobs and income generated by refuge activities.

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[2] It is important to note that employee compensation represents a component of the change in output, and thus is not additive.

There are several reasons why these results likely overstate the true regional economic impacts of the proposed ALNWR: (1) The results of our analysis reflect a static comparison of the regional economy with and without the refuge in its entirety. In reality, the refuge will be developed over the course of 20 years. Over this time period, workers and other productive resources displaced will be re-employed in other areas and/or sectors. These types of adjustments are not accounted for in our analysis. Similarly, regional output will increase over this time period, thereby reducing the relative magnitude of the impacts; (2) These estimates should be considered in the context of larger trends in Wisconsin agriculture which indicate declining employment and acreage; (3) These impacts will be mitigated by engineering and construction expenditures by the FWS during the 20-year development period. Specifically, in total, these expenditures will contribute over $6 million in output, 37 jobs and nearly $900,000 in employee compensation; (4) Finally, trends in recreational participation (wildlife observation in particular) suggest that visitation to the refuge upon completion may be greater than our own prediction based on current data, thereby increasing the magnitude of expenditures and resultant contribution to the regional economy. Given these mitigating factors, the net regional economic impacts arising from the ALNWR are unlikely to be perceptible at the county level.

Analysis of potential tax implications of the ALNWR proposal, performed by the Wisconsin Department of Revenue (DOR), indicates that some increase may occur at the municipal level. These impacts range from an estimated two dollar increase on an average home in Caledonia to an estimated 17 dollar increase on an average home in Fairfield. This range reflects a potential increase in the average municipal property tax payment of one to 10 percent. Tax impacts on the county and school district level are likely to be negligible. Much like our regional economic impact analysis, the DOR analysis reflects a static comparison of the tax base with and without the refuge. Given that these changes are likely to occur over a 20-year period, marginal reductions in tax revenues in each individual year are likely to be offset entirely by state and FWS compensation.

In summary, the proposed ALNWR would have a small *net* effect on regional economic activity relative to baseline conditions and generate considerable social benefits. This assessment is based upon information provided by the FWS regarding the anticipated character and management of the ALNWR, as well as various assumptions regarding the economic changes expected. Thus, our results are sensitive to new information that would alter any of these assumptions.

The purpose of this study is to provide an assessment of the probable economic effects associated with the proposed Aldo Leopold National Wildlife Refuge (ALNWR) in the vicinity of Baraboo and Lake Delton, Wisconsin. Current proposals describe three refuge development scenarios, ranging from 6,400 to approximately 15,300 acres, to be implemented over the next 20 years. It is expected that restoration of marshes, sedge meadows and wet prairies will provide habitat for several migratory bird species, improve water quality, decrease downstream flooding and assist in re-establishing a cold water fishery. The proposed refuge area is adjacent to several areas of natural significance in Sauk and Columbia counties, including the Wisconsin Department of Natural Resources Pine Island Wildlife Area, a U.S. Fish and Wildlife Service (FWS) Waterfowl Production Area, and lands maintained by the Sand County and Aldo Leopold Foundations. Altogether, the proposed ALNWR provides an opportunity to preserve up to 25,000 acres of nearly contiguous wildlife habitat in the region.

Pursuant to National Environmental Policy Act guidelines, the economic analysis presented here fulfills, in part, requirements for an Environmental Assessment of the ALNWR proposal.[1] Land acquisition and changes in management practice associated with the ALNWR will generate both positive and negative economic effects. These effects are of two types: changes in regional economic activity and changes in net social welfare. The former refers to changes in production, employment and taxes in the local economy. The latter reflects changes in national economic welfare or additional benefits that accrue to patrons of the ALNWR above the dollar value of goods and services purchased to participate in recreational opportunities and other refuge amenities.

In our evaluation we compare current regional economic conditions with those forecast to prevail should the ALNWR proposal be implemented, in order to determine the net economic effects. As such, our analysis is predicated on information provided by the FWS and assumptions made with their approval. The most significant of these assumptions and additional caveats are described briefly below.

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[1] See 40 C.F.R   1508.9

- This analysis does not consider changes in welfare or economic activity from the standpoint of individual landowners in the ALNWR study area. Although our analysis assumes FWS acquisition of certain privately-held areas, we understand that landowners will pursue this option only if it beneficial for them to do so.

- The regional economic analysis of the ALNWR development alternatives is based on spatial and temporal information provided by the FWS. Our results are sensitive to deviations in this information. Because we assume that the FWS will in fact acquire the full extent of lands described in the proposal, our estimates are likely to represent an upper bound of both positive and negative regional economic impacts.

- As with the regional economic analysis, our analysis of the welfare benefits of the ALNWR is motivated in part by estimates of the likely visitation that the refuge will receive and the recreational and interpretive opportunities that it will provide. The statistical analysis we employ is intended to provide a more accurate estimate of visitation than extrapolating from similar refuges, by explicitly accounting for individual factors that determine the level of public use of a refuge. These estimates are dependent on currently available information from the FWS regarding the anticipated character and management of the ALNWR.

ECONOMIC IMPACTS ADDRESSED IN THIS STUDY

This report does not represent a comprehensive inventory of the potential economic changes and adjustments attributable to the proposed ALNWR. Instead, we address those of primary concern from a policy standpoint and for which adequate data exist. These categories are described briefly below.

- The regional economic analysis estimates changes in output and employment associated with three modifications to the local economy: (1) the removal of acreage within the proposed refuge area from agricultural production; (2) anticipated local spending by refuge visitors on provisions; (3) planned expenditures to be made in the local area by the FWS in constructing, operating and maintaining refuge facilities.

- Potential property tax implications of changes in land ownership.

- The social welfare benefits associated with recreational opportunities likely to be provided by the ALNWR. Specifically, deer and waterfowl hunting, trout fishing and wildlife observation are considered.

IMPACTS NOT QUANTIFIED OR OTHERWISE ADDRESSED

Establishment of the ALNWR may yield additional benefits excluded from this analysis due to insufficient data or because of their speculative nature. Some of these categories are listed below.

- Individuals may hold a value for the ALNWR, independent of their usage of the refuge, by virtue of its preserved and pristine nature (and cultural and historical significance), a concept referred to by economists as nonuse or existence value.[2]

- Restoration of wetland acres in the proposed refuge area may reduce flooding and in turn improve proximate surface and groundwater quality. Currently, data do not exist to support assessment of these potential benefits.[3] Other ecological services to be provided by the ALNWR include habitat provision for rare or threatened species.

- Property owners adjacent to the proposed refuge may enjoy benefits associated with restricted development on nearby parcels.

ORGANIZATION OF THE REPORT

The remaining chapters of this report are organized as follows:

- In Chapter 2, we provide a detailed description of the ALNWR area and proposal. In particular, we discuss trends in employment, income, agriculture and development and consider the refuge in the context of regional preserved and recreational areas. We also discuss the alternatives proposed for development of the refuge that motivate our analysis.

- In Chapter 3, we describe the analytic methods employed in our regional economic and national economic (welfare) analyses. In addition, we discuss the application of a statistical model to predict visitation to the ALNWR.

- In Chapter 4, we discuss changes in net social welfare associated with establishment of the ALNWR. Specifically, we consider the economic benefits of hunting, fishing and wildlife observation.

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[2] For example, Bishop and Boyle (1985) and Walsh et al. (1984) estimate the value individuals place on preservation of natural and wilderness areas. Similarly, Brookshire et al. (1983), Stevens et al. (1991), Stoll and Johnson (1984) and Bowker and Stoll (1988) estimate existence values for wildlife resources.

[3] Many studies have estimated the economic value of wetland services. For example, Thibodeau and Ostro (1981) examine the value of flood prevention, pollution reduction and other benefits associated with wetland acreage in the Charles River Basin in eastern Massachusetts. Their results suggest a per-acre value of approximately $150,000 (1981$).

- In Chapter 5, we present our analysis of the regional economic impacts associated with the proposed refuge alternatives. In particular, we evaluate the changes in land use distribution and management and any resultant tax implications.

**OVERVIEW OF THE ALNWR REGION
AND PROPOSAL**   **CHAPTER 2**

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        In this chapter, we describe the economic and natural environment surrounding the proposed ALNWR area to provide context for our analysis. In addition, we summarize the four possible refuge development scenarios and anticipated management of the proposed refuge.

DESCRIPTION OF THE REGION

        The proposed ALNWR refuge area is adjacent to the city of Baraboo, approximately 60 miles northwest of Madison, Wisconsin. The area includes lands in both Sauk and Columbia Counties, within the townships of Fairfield and Caledonia. Sauk and Columbia Counties occupy 838 and 774 square miles, respectively. The regional landscape is characterized by low rolling topography, forests, pasture and cropland segmented by the Wisconsin and Baraboo Rivers. Exhibit 2-1 provides a map of the region.

Demographics and the Regional Economy

        Population growth rates in Sauk and Columbia counties between 1990 and 1995 were eight and five percent, respectively. In comparison, population growth in the state of Wisconsin was approximately five percent during this time period. Between the years 2000 and 2020, population is expected to grow at equivalent annual rates for these two counties and roughly seven percent for the state. County population projections are provided in Exhibit 2-2.

<table>
<thead>
<tr><th colspan="5">Exhibit 2-2

Population Figures and Projections for Sauk and Columbia Counties, Wisconsin</th></tr>
<tr><th></th><th>1990</th><th>2000</th><th>2010</th><th>2020</th></tr>
</thead>
<tbody>
<tr><td>Sauk County</td><td>46,975</td><td>52,654</td><td>54,936</td><td>56,205</td></tr>
<tr><td>Columbia County</td><td>45,088</td><td>48,175</td><td>49,106</td><td>49,203</td></tr>
<tr><td>State of Wisconsin</td><td>4,891,769</td><td>5,287,825</td><td>5,512,313</td><td>5,676,793</td></tr>
<tr><td colspan="5">Source: Demographic Services Center
http://www.doa.state.wi.us/deir/queries/pproj4.idc. (June 3, 1999)</td></tr>
</tbody>
</table>

Per capita income in Sauk County was $19,222 in 1994, approximately 90 percent of the national average of $21,696. In the same year, per capita income in Columbia County was $18,927. Between 1989 and 1994, per capita income in both counties increased at nearly the national average (approximately two percent over these five years).[1]

Employment and compensation in the counties is dominated by the manufacturing, service and retail trade industries. Exhibit 2-3 indicates the distribution of employment across sectors for each county and for the state as a whole. In Sauk County approximately 18 percent of the working population commute outside of the county. In Columbia County, this figure is roughly 37 percent.[2] Of the approximately 20,000 housing units in Sauk County in 1990, nine percent are summer homes. In comparison, eight percent of the 19,000 units in Columbia County are seasonal.

<table>
<thead>
<tr><th colspan="4">Exhibit 2-3

Distribution of Employment in Sauk and Columbia Counties</th></tr>
<tr><th>Industry</th><th>Sauk County</th><th>Columbia County</th><th>State of Wisconsin</th></tr>
</thead>
<tbody>
<tr><td>Agricultural Services, Forestry and Fishing</td><td>1.2%</td><td>0.9%</td><td>0.5%</td></tr>
<tr><td>Mining</td><td>0.5%</td><td>0.3%</td><td>0.1%</td></tr>
<tr><td>Construction</td><td>5.8%</td><td>4.6%</td><td>4.5%</td></tr>
<tr><td>Manufacturing</td><td>27.9%</td><td>31.9%</td><td>26.7%</td></tr>
<tr><td>Transportation and Public Utilities</td><td>3.7%</td><td>6.2%</td><td>5.3%</td></tr>
<tr><td>Wholesale Trade</td><td>6.0%</td><td>5.9%</td><td>6.0%</td></tr>
<tr><td>Retail Trade</td><td>24.0%</td><td>23.4%</td><td>20.5%</td></tr>
<tr><td>Finance, Insurance and Real Estate</td><td>5.3%</td><td>3.7%</td><td>6.7%</td></tr>
<tr><td>Services</td><td>25.5%</td><td>23.1%</td><td>29.6%</td></tr>
<tr><td colspan="4">Source: Census Bureau Data
http://www.census.gov/statab/USA96. (June 3, 1999)</td></tr>
</tbody>
</table>

[1] ACN Community Profiles; *http://www.can.net/states_prof/wi/county. (May 25, 1999)*
[2] Ibid.

The portions of Sauk and Columbia Counties proposed for development of the ALNWR consist predominantly of agricultural land. In this particular area production is currently dominated by corn, soybean, alfalfa, and to a lesser extent, other vegetables.[3] For comparative purposes, Exhibit 2-4 describes the distribution of farms in the area and for the state.

Exhibit 2-4								
Distribution of Farms in Sauk and Columbia Counties by Type; 1992 and 1997								
	Number of Farms							
	Sauk County			Columbia County			State of Wisconsin		
	1992	1997	Percent change	1992	1997	Percent change	1992	1997	Percent change
Cattle and calves	985	934	-5%	784	693	-12%	45,227	38,832	-14%
Hogs and pigs	193	111	-42%	212	135	-36%	6,776	3,591	-47%
Sheep and lambs	53	56	6%	100	76	-24%	2,444	2,100	-14%
Hens (layers and pullets)	70	75	7%	57	45	-21%	2,860	2,534	-11%
Chickens (broilers)	14	14	0%	10	14	40%	504	587	16%
Corn for grain or seed	926	905	-2%	994	878	-12%	36,674	34,315	-6%
Corn for silage	618	509	-18%	443	355	-20%	28,701	22,498	-22%
Oats for grain	437	317	-27%	430	277	-36%	22,195	14,925	-33%
Soybeans	235	305	30%	386	448	16%	8,957	12,028	34%
Potatoes	4	5	25%	8	7	-13%	447	418	-6%
Hay	1112	1011	-9%	984	814	-17%	51,238	44,115	-14%
Vegetables	43	52	21%	264	182	-31%	4,269	3,288	-23%
Source: National Agricultural Statistics Service, 1997 Census of Agriculture *http://www.nass.usda.gov. (June 3, 1999)*								

REGIONAL ATTRACTIONS

The Sauk and Columbia Counties region attracts considerable visitation on an annual basis. There are several areas of natural, cultural and historical significance in the area (refer to Exhibit 2-1). These include the Devil's Lake, Mirror Lake and Natural Bridge State Parks. According to the local chamber of commerce, Devil's Lake State Park, which provides diverse recreational opportunities, receives roughly two million visitors annually.[4] Other attractions include the Circus World Museum, the Winter headquarters for the Ringling Brother's Circus between 1884 and 1918, which is considered a national Historic Landmark by the U.S. Department of the Interior. Fifteen miles northwest lies the well-known Wisconsin Dells area,

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[3] Personal communication with county agricultural extension officers Laura Paine and Paul Dietmann.

[4] Personal communication, Baraboo Chamber of Commerce June, 1999; Devil's Lake information available at *http://www.baraboonow.com/Devils_lake/devils2.htm. (June 3, 1999)*

which supports nearly 80 family attractions and receives hundreds of thousands of visitors each year.[5]

Preserved Areas

The region surrounding the proposed ALNWR area is characterized by several preserved natural areas. The Pine Island Wildlife Area, maintained by the Wisconsin DNR, is contiguous to the proposed refuge area and abuts the Wisconsin River to the north. East of the refuge area there exists a recently acquired FWS Waterfowl Production Area, which encompasses 834 acres. The Leopold Memorial Reserve, site of the well-known naturalists' farm and "shack" described in the 1949 *A Sand County Almanac,* lies two miles north of the ALNWR area. The Aldo Leopold Foundation, in cooperation with six private landowners maintains 1,400 acres of land in this vicinity. The foundation offers tours and educational programs and receives approximately 2,000 visitors a year.[6] Finally, the International Crane Foundation, located southwest of the refuge area, offers tours, exhibits and nature trails.

THE ALNWR PROPOSAL

In this section, we describe the current proposed alternatives for development of the refuge, as provided by the FWS. Exhibit 2-5 provides a detailed map of the proposed refuge area.

Proposed Alternatives

Four alternatives have been proposed for development of the ALNWR. Each is described in turn below; relevant areas are indicated in Exhibit 2-5:

- **Voluntary Acquisition Area and Voluntary Watershed Maintenance Zone** (Alternative A). Under this alternative, the FWS would focus on fee acquisition (from willing sellers) of the 5,109 Fairfield Marsh basin (the extent of muck soils and limited surrounding uplands) acres within two to five years. In addition, the FWS would seek to acquire in fee or easement, 3,386 acres of uplands adjacent to the marsh over the course of 20 years (during the interim, a combination of conservation easements, fee title or private conservation measures would be pursued based on each landowner's interest). Conservation practices consistent with existing land uses would be encouraged on 1,279 acres of the Leech Creek headwaters (as part of a Voluntary Watershed Maintenance Zone).[7] The Wisconsin DNR holds

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[5] Wisconsin Dells information available at *http://www.pro-stock.com/VisionWeb/Dells/www_dells_com.html. (June 3, 1999)*
[6] Personal communication, Buddy Huffaker of the Aldo Leopold Foundation.
[7] Conservation practices refer to existing state and federal programs, such as the wetlands reserve program, that involve payment to a landowner for pursuing conservation measures.

riparian easements along 80 percent of Leech Creek. The FWS would pursue additional easements or fee title as a low priority, or in special cases to assist a landowner. The total acreage represented by this alternative is 9,774.

- **Status Quo** (Alternative B). For this alternative, the FWS would not pursue land acquisition or easements, as described in Alternatives A, C and D, but rather continue to acquire land for waterfowl production areas in the vicinity and encourage habitat restoration on private lands through the Partners for Fish and Wildlife program.

- **Voluntary Acquisition Area and Entire Voluntary Watershed Maintenance Zone** (Alternative C). This scenario incorporates the features of Alternative A, with the addition of peripheral lands that drain into the Fairfield Marsh and Voluntary Acquisition Area. These would include lands adjacent to Interstate 90/94, the north-facing bluff of the Baraboo Hills, and a forested tract west of the Lower Narrows for a total of 5,498 additional acres. The FWS would seek to encourage conservation practices on these lands and to preserve existing habitats primarily through landowner incentives, cooperative agreements and easements. If none of these options were of interest to the landowner, but they would like to sell fee title, the FWS would consider that option in view of available funds and other priorities. The total acreage affected by this alternative is 15,272.

- **Voluntary Acquisition Area and Voluntary Watershed Maintenance Zone** (Alternative D). This alternative would focus on fee acquisition of the core Fairfield Marsh basin (5,109 acres) and promotion of voluntary conservation practices on the 1,279 acres surrounding the Leech Creek headwaters. The total acreage involved in this alternative is 6,388.

It is important to note that the total acreage figures presented above are not directly relevant to our analysis. Because plans for areas such as the Leech Creek headwaters and the remainder of the Voluntary Watershed Maintenance Zone entail voluntary conservation practices combined with existing land uses, they may not represent a significant change in economic activity, from the standpoint of agriculture or otherwise. These details are discussed further in Chapter 5.

Planned Public Use Opportunities and Management

Current plans for management of the ALNWR provide for a variety of interpretive and recreational opportunities on the refuge. It is anticipated that a visitor center, hiking trails, and hunting and fishing access parking lots would be constructed over the course of ten to twenty years. Restoration of the Fairfield Marsh area and Leech Creek meanders would be expected to increase hunting and fishing quality in the area, as well as create diverse wildlife observation opportunities. It is also expected that the refuge would serve as a significant environmental education resource to local schools and other organizations.

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National Wildlife Refuges are proposed because it is believed they will enhance the Nation's stock of natural assets and provide significant benefits to its citizens. While at times the costs of these assets may be more concentrated among regional residents than are the benefits, it is the welfare (or net social benefits) of all citizens that drives national programs. Clearly, any inequities for regional citizens must be recognized, examined, and minimized to whatever extent feasible. Thus, Economic Assessments examine not only social welfare, but also regional economic impacts.

Agriculture and tourism constitute important parts of Sauk and Columbia County's regional economy. There will be changes in land use and management brought about by development of the ALNWR and resultant effects on agricultural production. There will also be changes in resource related activities in the region. Both may have significant implications in terms of regional economic activity and net social welfare.

The following sections briefly describe the concepts, techniques and assumptions relevant to our economic assessment of these changes. First, social welfare benefits will be discussed. This will be followed by a section describing regional economic analysis methods. Finally, we discuss a simple model constructed for the purposes of estimating the magnitude of visitation expected at the ALNWR. The results of this model are a critical input for our national and regional economic analyses.

NATIONAL ECONOMIC (WELFARE) ANALYSIS

The application of welfare economics, in the context of natural resources and environmental quality, involves comparing alternative allocations to determine under what conditions society is better off. Social benefits and costs are measured primarily by individuals' "willingness to pay" (WTP), the amount of money an individual is willing to give up to ensure an increase in some environmental amenity. The sum of an individuals' WTP for services provided by a natural resource, net of any costs associated with consuming those services, is referred to as consumer surplus. For example, the ordinary demand curve pictured in Exhibit 3-1 is a graphical representation of an individuals' WTP for various quantities of a good. That is, at a price of two

dollars, an individual will consume four units (at a total cost of eight dollars). For each unit up to four, the individuals' WTP is greater than the price and thus the shaded triangular area represents surplus that accrues to the consumer (which in this simple case is equivalent to four dollars [1/2(4)*(4-2)]).

Exhibit 3-1

CONSUMER SURPLUS

Price

$4

CS

$2

D

Quantity

4
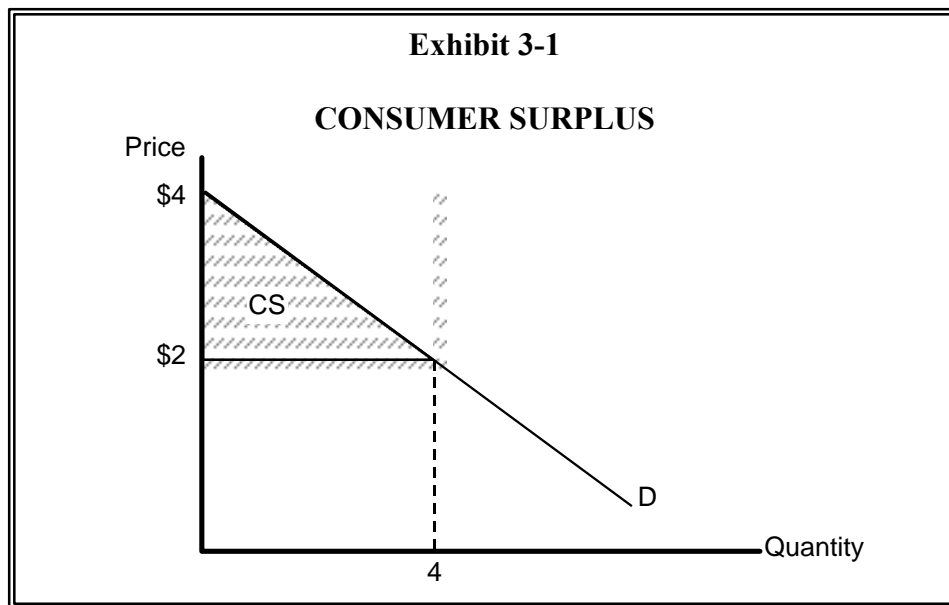
Consumer surplus provides a uniform and consistent means for quantifying the recreational benefits likely to be provided by the ALNWR. These measures differ from the regional economic indicators often discussed locally when national projects are proposed. For example, if a stream is closed to fishing, patron anglers forfeit the consumer surplus associated with a fishing day or trip to that area. Similarly, these anglers may incur greater travel expense to fish at a substitute site offering comparable attributes. However, while both of these adjustments result in a reduction (or possible elimination if the angler ceased to fish altogether) of consumer surplus, the angler is likely to continue making expenditures on provisions and gear in another area. As this example suggests, adjustments in resource accessibility or management such as these have differential effects on the regional and national economy. From a national perspective, gains and losses in the regional economy are typically offset by changes elsewhere once a new equilibrium is established and thus are distributive in nature. All that remains is the change in consumer surplus, which reflects changes in net economic value, an indication of societal economic well-being.

Measuring Consumer Surplus

Many services provided by natural resources are not traded in markets and therefore priced explicitly. As a result, economists have developed a variety of valuation techniques to elicit individual's willingness to pay for "nonmarket" commodities. These techniques can be grouped broadly into two categories: stated and revealed preference.

Stated preference refers to survey-based methods, such as contingent valuation, which rely upon hypothetical scenarios evaluated by a respondent to derive demand curves or direct valuation measures. These methods can be applied to a vast array of valuation questions; however, they are often subject to criticism because of potential biases and distortions associated with their hypothetical nature.

Revealed preference techniques rely upon observed behavior to infer individuals' values for nonmarket goods and services. The travel cost technique is a commonly used revealed preference method for valuing recreational resources. For example, data on the number of trips an individual takes to a lake and the costs and time incurred to travel there may be used to construct a demand curve for recreational opportunities at the lake (that is, a curve that demonstrates the relationship between the number of trips taken and the cost of those trips, presumably inverse). Changes in consumer surplus brought about by changes in accessibility, quality or management of the resource can be measured by observing shifts in the demand curve.

While these primary techniques are appropriate for our purposes, they are beyond the scope of this study. Instead, we utilize a secondary method of benefits assessment referred to as "benefits transfer." This approach is described below.

Overview of Benefits Transfer

Benefits transfer involves the application of unit value estimates, functions or models from existing valuation studies to address similar resource valuation questions. The technique has been widely applied in policy analysis and is approved for use in the U.S. Department of Interior guidance on recreation benefits assessment.[1] The process involves careful review of relevant literature to select those studies that most closely match the valuation exercise at hand in terms of physical characteristics of the resource, change in resource quality or quantity, and socioeconomic characteristics of the sample.[2]

Our analysis draws upon a wide body of economics literature to select appropriate per day and per trip consumer surplus values to estimate the economic contribution of recreational opportunities that will likely be provided by the ALNWR. To aggregate these values, we utilize estimates of visitation to the refuge, adjusted by activity type. The detailed results of our national economic (welfare) analysis are provided in Chapter 4.

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[1] U.S. DOI, *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies,* U.S. Water Resources Council, 1983.
[2] For example, Desvousges et al. (1992) and Boyle and Bergstrom (1992) discuss criteria for benefits transfer exercises.

REGIONAL ECONOMIC ANALYSIS

Regional economic modeling provides a means of estimating the impact of policy changes on a local economy by quantifying changes in output, employment and taxes. Due to the interconnected nature of industries in a geographic area, changes in one economic sector tend to have proportionally larger effects on regional output and employment (this concept is commonly referred to as the "multiplier" effect). To fully capture these impacts, we enlist an analytical technique referred to as "input/output modeling."

As outlined in Chapter 1, we consider three likely changes in the regional economy should the ALNWR proposal be implemented in full:

- The removal of agricultural acreage in the refuge study area from production.

- Local spending on provisions (food, lodging, etc.), and to a lesser extent, recreational equipment, by refuge visitors.

- Local spending associated directly with refuge construction and maintenance.

The estimates derived from this analysis represent changes in local, but not national, output and employment. Increases in output in the local economy reflect a redistribution of spending from another geographic area, not a net increase in national output. Similarly, decreases in output imply that this activity has been redirected elsewhere outside of the local area. As such, these effects are distributive in nature.

Overview of Input/Output Modeling

Industries in a geographic region are interdependent in the sense that they both purchase output from and supply input to other industries. Thus, the contribution of a particular industry to the regional economy is greater than its individual output. For example, farmers sell their output to distributors and, at the same time, purchase machinery, feed and other raw materials from regional producers. Thus, an increase in the demand for vegetables, grains, or dairy products will induce an increase in output and employment in these secondary industries. Similarly, a reduction in the demand for agricultural products will likely have greater regional output and employment effects than just those borne by local farmers.

Constructing a regional economic model requires interpretation of the complex relationships between industries. To simplify the analysis, industries that have similar effects on the economy are grouped together in sectors. These sectors are arrayed in an *input/output matrix*, which demonstrates how the input requirements of each sector are fulfilled by the output of other sectors. This matrix is utilized to generate values referred to as *multipliers*. Multipliers quantify the relationship between the demand for output from a given sector and the coincident output required of the regional economy. For example, an output multiplier of 1.5 associated with the agricultural sector implies that spending of $1.00 for agricultural products generates $1.50 in total output by the regional economy (i.e., secondary contributions by manufacturers of

equipment, raw materials and all other industries). Thus, the estimated contribution of a given sector to the regional economy is ultimately proportional to the size of its multiplier.

An important feature of developing a regional economic model is the definition of the "study area." This area should capture the economic relationships through which proposed policy changes will travel in the region of interest. Specifically, it should include the actual site of the impact, the regional location of secondary industries similarly affected, the residential location of the labor force and relevant pathways through which goods and services flow. For the purposes of our analysis, we assume that the relevant regional economy is reasonably approximated by Sauk and Columbia Counties.

Overview of the IMPLAN Model

To estimate the regional economic effects of the ALNWR proposal, we utilize MicroIMPLAN (IMpact Analysis for PLANning), an input/output model designed by the U.S. Forest Service.[3] Many state and federal planning agencies use IMPLAN for policy planning and evaluation purposes. The IMPLAN model draws upon data from a number of federal and state entities, including the Bureau of Economic Analysis and the Bureau of Labor Statistics. To group related industries into sectors, IMPLAN utilizes the categories defined by the U.S. Office of Management and Budget's Standard Industrial Classification (SIC) Code.

We utilize IMPLAN to develop three models corresponding to the categories described above. In each case, we posit a change in output in the appropriate sectors corresponding to the change in land use or local spending. The model then calculates the concomitant change in demand for inputs to those industries, changes in output of those secondary industries and so on. The model traces these changes in demand, output and employment, which can be classified as *direct*, *indirect*, or *induced*, depending on the source of the change.

- *Direct effects* are changes in production resulting from a change in demand or a supply shock. These are specified initially by the modeler.

- *Indirect effects* are changes in production in industries linked to those affected directly. For example, a decrease in agricultural production will decrease demand for seed and fertilizer and thus affect suppliers of those inputs.

- *Induced effects* reflect changes in household consumption resulting from changes in employment brought about by direct and indirect effects. For example, decreased employment in a region may result in decreased consumption of certain services.

These categories are calculated for all industries and aggregated to determine the regional output and employment effects resulting from the original change in production. The detailed results of our analysis are provided in Chapter 5.

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[3] The IMPLAN model is owned and maintained by the Minnesota IMPLAN Group, Inc. (MIG).

Caveats to IMPLAN Analyses

The IMPLAN model estimates only those effects resulting from a specific policy change, and thus does not account for adjustments that may occur over time. For example, a reduction in local agricultural output may encourage suppliers of raw materials to diversify their operations and thereby moderate local employment and output losses in that sector.[4] This scenario would not be reflected in estimates from the model. In addition, IMPLAN does not consider the re-employment of workers displaced by the original policy change. As these examples suggest, net changes in output and employment may be smaller than those estimated by the model, which provides an approximation of regional economic impacts.

An additional consideration associated with IMPLAN model analyses relates to the year of data relied upon. The IMPLAN model utilizes input/output data from 1994. In this analysis, we rely upon this characterization of the 1994 regional economy to approximate current conditions, as well as economic relationships in the future (up to 20 years). This is a limitation of input/output modeling in general and not exclusive to the IMPLAN model. Nonetheless, it is important to note that the nature of the local economy may change over this time, and thus our results may be sensitive to this assumption.

ALNWR VISITATION MODEL

In this section, we describe a simple cross-sectional visitation model constructed for the purpose of estimating the likely magnitude of annual visitors to the ALNWR. An alternative approach would be to extrapolate annual visitation estimates from refuges with attributes similar to those proposed for the ALNWR. This model represents a formalized extension of this approach, in that it draws upon a large sample of refuges and controls statistically for refuge differences expected to influence visitation. In this manner, the marginal influence of each feature can be estimated and applied to the anticipated features of the ALNWR.

Model Estimation and Results

To construct our model we draw upon visitation and attribute data for 61 refuges in 12 states obtained from the Refuge Management Information System (RMIS) and on-line sources.[5] Our specification posits annual visitation as a function of the size, recreational and interpretive opportunities, accessibility, and availability of substitutes for each refuge. Results of ordinary least squares estimation of the model and variable definitions are presented in Exhibit 3-2.[6] Variable summary statistics and a sample correlation matrix are provided in the appendix to this chapter.

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[4] This is particularly relevant to this analysis, as land transformation would occur over an extended time period.

[5] These states include U.S. FWS Region 3 and the eastern portion of Region 6. Individual refuge information available on-line at *http://refuges.fws.gov/NWRSFiles/General/Query.html*

[6] Models were estimated using STATA Statistics and Data Analysis package v.5

Exhibit 3-2

Regression Results and Variable Definitions for ALNWR Visitation Model

Dependent Variable: Number of Visits (1995)

$N = 55$ $R^2 = .58$ $F = 5.44$

Variable	Coefficient	t-statistic	p-value
constant	25,480.49	2.295	0.026
acres	.62	1.088	0.282
family and interpretive	2,208.08	0.742	0.462
archeological and historical	117,806.90	2.511	0.015
other refuges	-3,604.45	-1.483	0.145
distance to population center	-96.59	-1.801	0.078
special events	1,020.14	0.693	0.492

acres: size of refuge in acres
family and interpretive: number of family and interpretive opportunities (i.e., presence of visitor center, contact station, wildlife observation, hiking trails, auto route and educational programs)
archeological and historical: refuge includes sites of archeological or historical significance
other refuges: number of other refuges in county
distance to population center: distance in miles to nearest metropolitan area with population greater than 50,000
special events: number of special refuge events per year

Notes: Six observations were eliminated from the original sample utilizing Cook's Distance test for influential observations and a critical value of 4/N. In addition, a Huber-White correction for heteroskedasticity was applied to obtain robust standard errors. This correction does not alter parameter estimates.

Estimation results suggest that our model explains approximately 60 percent of the variation in annual refuge visitation for this area. Although not widely significant, signs on coefficients are as anticipated.[7] Visitation varies directly with the size of the refuge, the number of family and interpretive opportunities, the presence of archeologically or historically significant sites and the number of special events each year. For example, each additional family and interpretive opportunity at a refuge in the sample attracts approximately 2,200 persons each year. Visitation varies inversely with distance to an urban area and the number of other refuges

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[7] Both the archeological and historical and distance to population center variables are significant at the .10 level. This indicates that we are 90% confident that these parameter estimates are different from zero. The t-statistics presented in Exhibit 3-2 provide a measure of each coefficient's significance given the size of the sample and the number of parameters estimated. The corresponding p-values provide an exact measure of the confidence level of parameter significance.

in the county. For example, each one-mile increase in distance between a refuge in the sample and the nearest metropolitan area results in a reduction of roughly 97 persons each year. Due to insufficient variation across refuges in the sample, an index of recreational opportunities (hunting, fishing and motorized and non-motorized boating) was excluded from the model.

To derive an estimate for annual visitation to the ALNWR, we combine the parameter estimates above with anticipated refuge attribute information.   These assumptions and calculations are summarized in Exhibit 3-3.

<table>
<tr><td colspan="4" align="center">Exhibit 3-3

Evaluation of ALNWR Visitation Model</td></tr>
<tr><td align="center">Variable</td><td align="center">Coefficient</td><td align="center">Anticipated at ALNWR</td><td align="center">Visitation (persons)</td></tr>
<tr><td>acres</td><td align="right">.62</td><td align="right">6,388 to 15,272 acres</td><td align="right">4,000 to 9,500</td></tr>
<tr><td>family and interpretive</td><td align="right">2,208.08</td><td align="right">5</td><td align="right">11,000</td></tr>
<tr><td>archeological and historical</td><td align="right">117,806.90</td><td align="right">Yes [a]</td><td align="right">117,800</td></tr>
<tr><td>other refuges</td><td align="right">-3,604.45</td><td align="right">No other refuges in either county</td><td align="right">0</td></tr>
<tr><td>distance to population center</td><td align="right">-96.59</td><td align="right">37 miles to Madison, WI</td><td align="right">-3,574</td></tr>
<tr><td>special events</td><td align="right">1,020.14</td><td align="right">None assumed</td><td align="right">0</td></tr>
<tr><td>constant</td><td align="right">25,480.49</td><td></td><td align="right">25,500</td></tr>
<tr><td colspan="3" align="right">Total:</td><td align="right">154,700 to 160,200</td></tr>
<tr><td colspan="4">[a] Historical and cultural significance attributable to Aldo Leopold's association with the area.</td></tr>
</table>

As shown, our model predicts visitation to the ALNWR to be on the order of 155,000 to 160,000 visits (persons) annually, depending on acreage. For comparative purposes, the Necedah and Horicon refuges in Wisconsin received 143,794 and 529,035 visits respectively in 1997. Although there is some uncertainty associated with our estimates, we feel they provide an order-of-magnitude indication of the likely visitation to the ALNWR, should refuge attributes and management practice remain consistent with current proposals.

Caveats to Visitation Model Results

It is important to point out several caveats associated with the estimates from our visitation model. Perhaps most importantly, the reliability of these estimates is contingent upon the integrity of the underlying visitation data. To the extent that accounting policies differ across refuges, some bias may be present in our estimates. In addition, the variables we included are subject to differences in measurement across refuges, such as the definition of an "event." Finally, there are likely differences in management practice and non-refuge recreational substitutes across areas that are not captured by the variables in our specification.

APPENDIX

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┌─────────────────────────────────────────────────────────────────────────────┐
│                                                                             │
│                         Sample Correlation Matrix                           │
│                                                                             │
├─────────────────────────────────────────────────────────────────────────────┤
│                                                                             │
│         | visits95    acres faminter archhist  othrefs  distpop   events   │
│ --------+------------------------------------------------------------------ │
│ visits95|   1.0000                                                          │
│    acres|   0.1788   1.0000                                                 │
│ faminter|   0.4907   0.5033   1.0000                                        │
│ archhist|   0.6582  -0.0904   0.3362   1.0000                               │
│  othrefs|  -0.2898  -0.0606  -0.1922  -0.0906   1.0000                      │
│  distpop|  -0.3949   0.0526  -0.3931  -0.2329   0.5337   1.0000             │
│   events|   0.3301   0.2477   0.5372   0.2592   0.0531  -0.1921   1.0000    │
│                                                                             │
└─────────────────────────────────────────────────────────────────────────────┘
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┌─────────────────────────────────────────────────────────────────────┐
│                                                                     │
│                         Summary Statistics                          │
│                                                                     │
├─────────────────────────────────────────────────────────────────────┤
│                                                                     │
│ Variable |    Obs       Mean   Std. Dev.       Min        Max       │
│ ---------+--------------------------------------------------------- │
│ visits95 |     55  29,452.64  53372.23          89    309,288      │
│    acres |     55  11,301.18  14405.18         148     61,500      │
│ faminter |     55       3.14  2.189353           0          6      │
│ archhist |     55        .07  .2620818           0          1      │
│  othrefs |     55       2.64  1.984791           1          8      │
│  distpop |     55     117.45  82.15068           9        297      │
│   events |     55       2.22  3.578179           0         21      │
│                                                                     │
└─────────────────────────────────────────────────────────────────────┘
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In this chapter, we evaluate the probable economic contribution of the ALNWR from a social welfare perspective. As described in Chapter 3, this involves estimating the net benefits that will accrue to refuge users, as measured by consumer surplus. In the sections that follow we describe the allocation of our visitation estimates to three primary recreational activities that will occur on the refuge (hunting, fishing and wildlife viewing) and the literature and data considered in selecting appropriate values for our analysis. We then apply the annual visitation estimates from our model, adjusted by activity type, to determine aggregate annual benefits by activity.

DISTRIBUTION OF VISITS TO THE ALNWR

As discussed in Chapter 3, the results of our model suggest that visitation to the ALNWR is likely to be on the order of 155,000 to 160,000 persons per year, depending on the acreage of the refuge. To allocate these trips by activity, we apply the distribution of trips in 1997 to the nearby Necedah NWR in Necedah, Wisconsin.[1] Furthermore, we utilize information from the 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation for Wisconsin to apportion big game and waterfowl hunting trips. These estimates are provided in Exhibit 4-1.

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[1] We feel that this is a reasonable approximation of the distribution of trips to the proposed ALNWR given similar recreational opportunities, species availability and management.

Exhibit 4-1		
Expected Distribution of Trips to the ALNWR by Activity		
Model Prediction	Percentage Trips to Necedah NWR	Number of Trips to ALNWR
155,000 to 160,000	Wildlife Observation (88%)	136,400 to 140,800
	Fishing (5%)	7,800 to 8,000
	Hunting (7%)	
	Big Game (85%)	9,200 to 9,500
	Waterfowl (15%)	1,600 to 1,700
Sources: Refuge Management Information System data 1997 and 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation- Wisconsin; U.S. Departments of the Interior and Commerce; Table 11, p.23		

RECREATIONAL VALUES FOR THE ALNWR

To select values for our welfare analysis of recreational opportunities, we conducted searches of peer-reviewed journals, working papers and other sources to identify applicable estimates. Our selection reflects studies that most closely match our criteria with respect to the commodity valued and study area.

Hunting

Current public use and management plans provide for small and big game and waterfowl hunting opportunities within the refuge as well as the creation of hunting access parking lots. Hunting currently occurs on some of the lands included in the refuge proposal through arrangements with private landowners. To the extent that additional lands are made available for hunting, or can be accessed at a lower cost, the ALNWR will generate additional welfare benefits to hunters. In addition, it is anticipated that restoration of the Fairfield Marsh will increase local production of duck, potentially improving the quality of local waterfowl hunting.

To estimate the welfare benefits associated with hunting opportunities at the ALNWR, we draw upon estimates for similar commodities from the economics literature. Specifically, we select studies that provide estimates of the welfare value of hunting opportunities (denominated in days or trips) for deer and waterfowl.[2] Exhibit 4-2 provides summary information for these studies.

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[2] These are likely to be the primary species hunted on the ALNWR.

<table>
<tr><td colspan="5" align="center">**Exhibit 4-2**

Summary of Hunting Welfare Values</td></tr>
<tr><td></td><td>**Author (date)**</td><td>**Study Location**</td><td>**Species**</td><td>**Value (1998$)[a]**</td></tr>
<tr><td>Big Game</td><td>Waddington, Boyle and Cooper (1994)</td><td>Wisconsin</td><td>Deer</td><td>$35.86 per day</td></tr>
<tr><td></td><td>Hay (1988)</td><td>Wisconsin</td><td>Deer</td><td>$45.87 per day</td></tr>
<tr><td></td><td>Luzar, Hotvedt and Gan (1992)</td><td>Sherburne WMA, Louisiana</td><td>Deer</td><td>$19.63 per trip</td></tr>
<tr><td>Waterfowl and Migratory Birds</td><td>Sorg and Nelson (1987)</td><td>Idaho</td><td>Waterfowl</td><td>$43.87 per trip</td></tr>
<tr><td></td><td>Cooper and Loomis (1993)</td><td>San Joaquin NWRs, California</td><td>Waterfowl</td><td>$31.52 per trip</td></tr>
<tr><td></td><td>Hay (1988)</td><td>Wisconsin</td><td>Waterfowl</td><td>$12.90 per day</td></tr>
<tr><td colspan="5">[a] Welfare values are adjusted to current dollars using the GDP implicit price deflator. Travel cost estimates are chosen over those derived from contingent valuation or other stated-preference methods for studies that provide both.</td></tr>
</table>

While these welfare estimates reflect hunting conditions, choice of substitute sites and respondent characteristics that are likely to differ from those associated with the ALNWR, they nonetheless provide an order-of-magnitude indication of the welfare value of refuge hunting opportunities. Given these uncertainties, we develop an upper and lower bound estimate for each type of hunting activity, based on the range of values above. We then apply the adjusted visitation estimates described previously to determine the annual value of each hunting activity. Exhibit 4-3 presents these results.

<table>
<tr><td colspan="7" align="center">**Exhibit 4-3**

Estimated Annual Economic Value for Hunting Opportunities on the ALNWR (1998$)</td></tr>
<tr><td></td><td colspan="2" align="center">**Annual Trips**</td><td colspan="2" align="center">**Welfare Estimate**</td><td colspan="2" align="center">**Annual Estimate of Value**</td></tr>
<tr><td></td><td>Lower Bound</td><td>Upper Bound</td><td>Lower Bound</td><td>Upper Bound</td><td>Lower Bound</td><td>Upper Bound</td></tr>
<tr><td>Big Game</td><td>9,200</td><td>9,500</td><td>$20</td><td>$46</td><td>$184,000</td><td>$437,000</td></tr>
<tr><td>Waterfowl</td><td>1,600</td><td>1,700</td><td>$13</td><td>$44</td><td>$21,000</td><td>$75,000</td></tr>
<tr><td colspan="5" align="right">**Total:**</td><td>**$205,000**</td><td>**$512,000**</td></tr>
</table>

Fishing

Restoration of Leech Creek meanders in the Fairfield Marsh basin will roughly double the existing amount of habitat for trout. Currently, the upper portion of the creek is classified as a Class II trout stream by the Wisconsin DNR, yet is subject to limited use. It is anticipated that the DNR will upgrade stocking efforts in the future. In addition, refuge plans indicate that at least one accessible bank fishing area will be developed. Other angling opportunities within the

proposed refuge area include smallmouth bass, catfish, carp and bullhead fishing on lower reaches of the Baraboo River. Fishing quality in this area may also improve in the future as additional upstream dams are removed, increasing the population of bass substantially. The DNR may also consider establishing a sturgeon run in this area.[3] These additional improvements are not, however, quantified herein.

To estimate the welfare value of fishing opportunities provided by the ALNWR, we focus on increased brook and brown trout fishing in the Leech Creek environment. To select appropriate studies for this purpose, we queried the U.S. FWS Sport Fishing Valuation Database, which records detailed information on over 100 travel cost and contingent valuation studies of the economic value of sport fishing opportunities in the conterminous United States.[4] Exhibit 4-4 provides summary information for these studies.

Exhibit 4-4			
Summary of Fishing Welfare Values			
Author(date)	Study Location	Species Valued	Value (1998$)
Brown and Hay (1980)	Wisconsin	Trout	$16.80 per day
McCollum, Peterson, Arnold, Markstrom and Hellerstein (1990)	Forest Service Region 9	Coldwater	$11.66 per day
Loomis, Sorg and Donnelly (1986)	Idaho	Trout	$28.41 per day

Similar to our estimate of the welfare value of hunting opportunities, we develop a range of values for trout fishing based on the results of our database search and apply these to our estimate of the number of recreational fishing trips to the refuge to determine annual economic value. Exhibit 4-5 presents these results.

Exhibit 4-5					
Estimated Annual Economic Value for Trout Fishing Opportunities on the ALNWR (1998$)					
Annual Trips		Welfare Estimate		Annual Estimate of Value	
Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound
7,800	8,000	$12	$28	$93,600	$224,000

---

[3] Information in this section is based in part on personal communication with Steve Winters of the Badger Fly Fishers organization.

[4] For documentation refer to Boyle et al., "A Database of Sport Fishing Values," prepared for the U.S. Fish and Wildlife Service.

Wildlife Viewing

Wildlife viewing and related interpretive activities are likely to account for the predominant portion of trips to the ALNWR. Restored wetland areas in the refuge may support a number of rare bird species, including the American bittern, sedge wren, loggerhead shrike, eastern meadowlark, wood duck and the golden-winged warbler. Altogether, the area will provide habitat for 23 bird species listed as Resource Conservation Priorities by Region 3 of the U.S. FWS or State species of Special Concern by the Wisconsin DNR. To estimate the value of wildlife observation and related activities likely to be provided by the ALNWR, we consider relevant welfare estimates, summarized in Exhibit 4-6.

<table>
<tr><td colspan="4" align="center">Exhibit 4-6

Summary of Wildlife Viewing Welfare Values</td></tr>
<tr><td>Author(date)</td><td>Study Location</td><td>Activity</td><td>Value (1998$)</td></tr>
<tr><td>Waddington, Boyle and Cooper (1994)</td><td>Wisconsin</td><td>Wildlife Observation</td><td>$31.23 per day</td></tr>
<tr><td>Hay (1988)</td><td>Wisconsin</td><td>Wildlife observation, photography and feeding</td><td>$21.50 per day</td></tr>
<tr><td>Eubanks, Ditton and Stoll (1998)</td><td>Nebraska</td><td>Wildlife observation (birding)</td><td>$27.63 per day</td></tr>
<tr><td>Cooper and Loomis (1989)</td><td>California</td><td>Deer Viewing</td><td>$20.33 per trip</td></tr>
</table>

Again, we apply the above range of welfare estimates to our range of expected wildlife observation related trips to the ALNWR to determine the annual economic value. Exhibit 4-7 presents these results.

<table>
<tr><td colspan="6" align="center">Exhibit 4-7

Estimated Annual Economic Value for Wildlife Viewing Opportunities on the ALNWR (1998$)</td></tr>
<tr><td colspan="2" align="center">Annual Trips</td><td colspan="2" align="center">Welfare Estimate</td><td colspan="2" align="center">Annual Estimate of Value</td></tr>
<tr><td>Lower Bound</td><td>Upper Bound</td><td>Lower Bound</td><td>Upper Bound</td><td>Lower Bound</td><td>Upper Bound</td></tr>
<tr><td>136,400</td><td>140,800</td><td>$20</td><td>$31</td><td>$2,728,000</td><td>$4,365,000</td></tr>
</table>

Total Economic Value of ALNWR Recreational Opportunities

The total economic value of the three recreational opportunities likely to be provided by the ALNWR ranges from approximately three to five million dollars annually. As shown in Exhibit 4-8, the majority of these benefits is attributable to the large number of wildlife viewing trips.

Exhibit 4-8		
Total Annual Estimated Economic Value for Recreational Opportunities on the ALNWR (1998$)		
Activity	**Lower Bound Estimate**	**Upper Bound Estimate**
Hunting	$205,000	$512,000
Fishing	$93,600	$224,000
Wildlife Viewing	$2,728,000	$4,365,000
Total:	**$3,027,000**	**$5,101,000**

SUMMARY AND CONCLUSIONS

The ALNWR may create substantial social benefits by providing additional hunting, fishing and wildlife viewing opportunities to the region. It is important to note that the estimates in this chapter reflect the total economic value of recreational opportunities on the proposed ALNWR. Although some of these activities currently take place on lands within the proposed refuge area, sufficient data do not exist to quantify the marginal change in accessibility or quality. Thus, our analysis may overstate the benefits associated with these activities in the context of the ALNWR proposal.

In addition, the results presented in this chapter are based, in part, upon visitation estimates derived from the model discussed in Chapter 3. As such, the benefit estimates presented within are sensitive to assumptions made in developing and evaluating the model and ultimately, the integrity of underlying visitation and refuge characteristic data that comprised the sample. Initially, recreation benefits are likely to be lower than those described in this chapter and increase over time until full establishment of the refuge. Although implementation costs (i.e., purchase of land and construction of facilities) end at a set time, recreational benefits are recurring and based upon current estimates of visitation projected into the future. It has been observed that participation in wildlife observation (in particular) has increased substantially over the past decade. This fact challenges our constant visitation assumption and suggests that future benefits may in fact be greater.

_____

Changes in land use and management associated with the ALNWR proposal may alter the character of the regional economy. In this chapter we consider the magnitude of these changes, relying upon input/output modeling techniques described in Chapter 3. Specifically, we estimate impacts arising from:

- A reduction in regional agricultural output attributable to conversion of arable land.

- An increase in local spending by visitors to the refuge.

- Expenditures in the local area by the FWS for construction, operation and maintenance of proposed refuge facilities.

Finally, we examine the tax implications of public ownership of lands included in the ALNWR proposal.

In general, the results of our analysis suggest a slight net reduction in regional economic activity equivalent to four to seven *one-hundredths* of one percent of baseline output on an annual basis. Analysis of potential property tax impacts suggest that appreciable effects are unlikely, although some change may occur at the municipal level.

THE ALNWR REGIONAL ECONOMIC MODEL

As discussed in Chapter 3, for the purposes of this report we assume that the relevant regional economy is comprised of Sauk and Columbia Counties. The estimates presented here reflect changes in output and employment within this area only and do not incorporate concurrent adjustments in other counties or states.   In addition, these estimates are static in nature and reflect a constant baseline characterization of the regional economy. Thus, changes in output, employment and employee compensation may be overstated to some degree. For example, as agricultural land is incrementally

removed from production in the proposed refuge area, compensating adjustments (i.e., re-employment of displaced workers and re-allocation of other productive resources) are likely to occur within the regional economy. It is unlikely that a similar magnitude of output and employment losses would continue indefinitely into the future. These types of adjustments are not accounted for in this analysis. Exhibit 5-1 reflects the baseline data for the study area.

Exhibit 5-1		
Combined Baseline Data for all Industries in Sauk and Columbia Counties		
	Baseline Estimate (1998$)[a]	**Description**
Total Industry Output	$4,661,000,000	Total output of all regional industries
Employment (persons)	61,000	Total employment of all regional industries
Employee Compensation	$1,302,000,000	Total employee compensation in region
Source: IMPLAN Data Files for Sauk and Columbia Counties		
[a] Output adjusted to current dollars using the GDP implicit price deflator.		

We use these baseline data to develop three models, as described in the sections that follow.

Changes in Agricultural Land Use

We first estimate declines in regional output, employment and employee compensation associated with the removal of arable land from production in the proposed refuge area. We focus on those lands incorporated in Alternatives A and D, the Fairfield Marsh basin and the adjacent, residual portion of the Voluntary Acquisition Area. We exclude peripheral areas associated with the Voluntary Watershed Maintenance Zone, as current land use practices are not likely to be altered in these areas.[1]

To apply the IMPLAN model we posit the elimination of agricultural output from the arable portions of the Fairfield Marsh basin (4,045 acres) and the remainder of the Voluntary Acquisition Area (1,340 acres).[2] To characterize baseline agricultural land use, we compiled information from the Sauk and Columbia Counties Agricultural Extension Officers, local farmers and the Wisconsin Agricultural Statistics Service (WASS). The composition of agricultural land use in the basin and adjacent portion of the Voluntary Acquisition Area is provided in Exhibit 5-2.
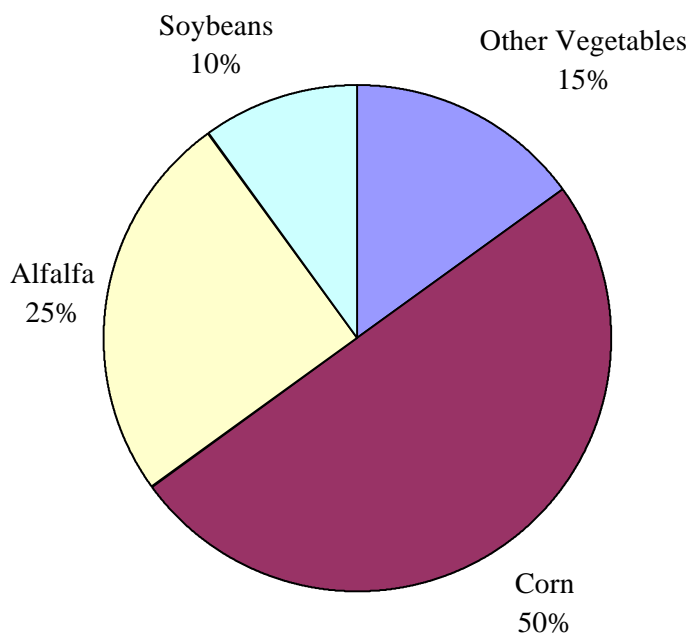
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[1] Except to the extent that some owners offer their land for fee title purchase, which can not be predicted.
[2] Extent of tillable acreage determined by Geographic Analysis Program (GAP) analysis of Wisconsin DNR data by the FWS.
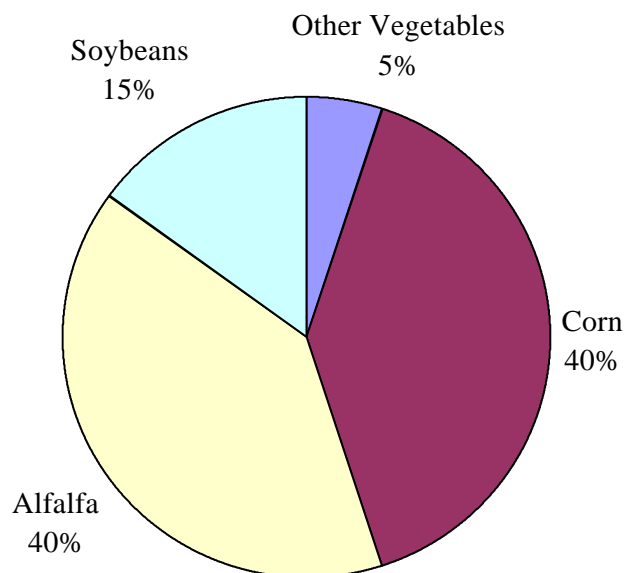
Exhibit 5-2

Distribution of Crops in Proposed ALNWR Area

Distribution of Crops in Fairfield Marsh Basin

Distribution of Crops in Adjacent Portion of Voluntary Acquisition Area

Source: Laura Paine and Paul Dietmann, Columbia and Sauk Counties Agricultural Extension Agents

To translate acreage into output estimates for entry into the IMPLAN model, we apply three-year (1986-1998) Wisconsin state average per-acre yield and price estimates for each type of crop, as provided by the WASS.[3] The results of the IMPLAN analysis indicate the annual reduction in regional output, employment and employee compensation associated with the reduction in agricultural acreage from the Fairfield Marsh basin and the Voluntary Acquisition Area as a whole, should the full extent of these areas be acquired by the FWS. These results are presented in Exhibit 5-3.

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[3] We also rely upon specific data provided by the Gumz Muck Farms. All other yield and price information provided by Kevin Pautler of the WASS.

		Exhibit 5-3		
Annual Economic Impacts of Reductions in Agricultural Activity Attributable to the ALNWR Proposal				
	Initial Reduction in Output Posited in Model	**Reduction in Regional Output (1998$)**	**Reduction in Regional Employment (persons)**	**Reduction in Employee Compensation (1998$)[a]**
Fairfield Marsh basin (4,045 tillable acres)	$2,837,000	$3,186,000	44	$525,000
Entire Voluntary Acquisition Area (5,385 tillable acres)	$3,629,000	$4,360,000	61	$691,000
[a] It is important to note that employee compensation represents a component of the change in output. Source: IEc IMPLAN analysis				

As shown in Exhibit 5-3, acquisition of the entire Fairfield Marsh basin would reduce regional output by over $3 million annually. Similarly, it would render a loss in regional employment of approximately 44 persons per year and annual employee compensation of over $500,000. Acquisition of the entire Voluntary Acquisition Area would expand these output losses to over $4 million per year. Approximately 61 jobs in the region and nearly $700,000 in employee compensation would also be forfeited.

Recreational Activity

In this section we develop an additional model to estimate the economic impact of recreational activities on the proposed ALNWR. As described in Chapter 3, our visitation model suggests that visitation to the proposed ALNWR is likely to be on the order of 155,000 to 160,000 persons annually. However, many of these trips will be incidental in nature. That is, visitors already in the area will include the refuge in their itinerary, even though it was not their primary destination. Only those trips that would otherwise not be taken, but for the refuge, represent new spending in the region. To isolate those contributions to the local economy associated exclusively with the ALNWR, we adjust our visitation estimate accordingly. Given the diversity of recreational opportunities and attractions in the area, we feel that approximately 10 percent of the total annual visitation predicted by our model will represent (a conservative estimate of) primary purpose trips (i.e., trips that would not otherwise be taken in the absence of the refuge). Unfortunately, little research has been conducted on the implications of primary versus incidental trips to regions that offer numerous recreational areas.[4] Nonetheless, we feel that our estimate is conservative (i.e., low) and appropriate for our purposes. We

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[4] The National Park Service is currently undertaking research to investigate the effects of trip orientation on welfare values for recreational activities within certain parks.

utilize the distribution of annual trips by recreational activity to the Necedah NWR in Necedah, Wisconsin to apportion our estimate of new trips into three primary categories: hunting, fishing and wildlife viewing.

Recreational activities affect the regional economy through consumer purchases of recreation-related goods and services. Thus, determining the contribution of these activities involves estimating visitor expenditures per recreation day for each of these activities. These estimates are provided in Exhibit 5-4.

Exhibit 5-4			
Estimated Per-Day Expenditures by Recreational Activity			
	Hunting	Fishing	Wildlife Viewing
Transportation	$5.08	$6.68	$10.76
Food	$6.25	$8.43	$17.00
Lodging	$0.91	$4.58	$5.73
Equipment	$11.19	$7.87	$26.46
Ice/Bait	N/A	$1.93	N/A
TOTAL:	$23.43	$29.49	$59.95
Source: 1996 National Survey of Fishing, Hunting and Wildlife-Associated Recreation: Wisconsin			

As shown, the primary IMPLAN sectors affected by recreational activities are hotels and lodging, grocery stores and restaurants, sporting goods stores and transportation. Because only a portion of recreational visitors to the area are likely to make equipment purchases, we assume that one-third of all visitors make such expenditures. For example, hunters who live outside of the region may purchase ammunition near their homes. Thus, the model avoids overestimating regional effects by adjusting for these extra-regional expenditures. We apply the per-day expenditures described in Exhibit 5-4 to our estimates of annual visitation by recreational activity to determine the annual increase in spending in the regional economy. In Exhibit 5-5 we present a range of results based on: (1) the range of adjusted visitation, as predicted by our model, and determined ultimately by the acreage of the refuge, (2) the assumption that either one-half or all of the visitors to the region purchase food locally.

Exhibit 5-5 presents the results of our IMPLAN analysis of the regional economic contribution of ALNWR visitor expenditures. These estimates reflect the annual contribution to regional output, employment and employee compensation of recreational activities on the refuge. As shown, wildlife viewing accounts for the most significant contribution in all three categories, both because of its higher level of associated expenditures per activity day and the greater number of trips taken for this purpose. Together, the three activities may contribute as much as $749,000 to $985,000 per year to regional output.

	Estimated Number of Annual Trips	Initial Increase in Spending Posited in Model	Contribution to Regional Output (1998$)	Contribution to Regional Employment (persons)	Contribution to Employee Compensation (1998$)
Exhibit 5-5					
Annual Regional Economic Contribution of ALNWR Recreational Opportunities					
Hunting	1,083 to 1,122	$14,000 to $18,000	$22,000 to $28,000	1	$5,000 to $7,000
Fishing	774 to 801	$15,000 to $19,000	$23,000 to $30,000	1	$6,000 to $8,000
Wildlife Viewing	13,616 to 14,100	$456,000 to $595,000	$704,000 to $927,000	18 to 23	$184,000 to $245,000
TOTAL:	15,473 to 16,023	$485,000 to $632,000	$749,000 to $985,000	20 to 25	$195,000 to $260,000
Source: IEc IMPLAN analysis					

Construction and Maintenance of Refuge Facilities

Expenditures by the FWS for construction of a visitor center and other refuge facilities, as well as annual operating and maintenance expenses, constitute direct expenses that contribute to the local economy. To estimate the impact of these expenditures, we rely upon construction and annual cost estimates provided by the FWS. The cost estimate for restoration engineering and construction of a visitor center, staff office space, roadside pullouts, trails and interpretive signs is a total of roughly $3.8 million over the course of 20 years. The estimated total contribution to regional output, employment and employee compensation over this period is provided in Exhibit 5-6.

Initial Increase in Spending Posited in Model	Contribution to Regional Output (1998$)	Contribution to Regional Employment (persons)	Contribution to Employee Compensation (1998$)
Exhibit 5-6			
Total Regional Economic Contribution of ALNWR Engineering and Construction Expenditures			
$3,800,000	$6,135,000	37	$882,000
Source: IEc IMPLAN analysis			

In addition, the FWS estimates annual operating and maintenance expenditures to be on the order of $600,000. To apportion this amount among employee salaries, building and equipment maintenance, services and supplies, we utilize the distribution of related expenditures from the Horicon NWR in Wisconsin (approximately 60%, 5%, 21%

and 14%, respectively). The estimated annual contribution to regional output, employment and salaries resulting from refuge operating and maintenance expenditures is provided in Exhibit 5-7.

Exhibit 5-7 Annual Regional Economic Contribution of ALNWR Operating and Maintenance Expenditures			
Initial Increase in Spending Posited in Model	Contribution to Regional Output (1998$)	Contribution to Regional Employment (persons)	Contribution to Employee Compensation (1998$)
$600,000	$495,000[a]	8	$148,000
[a] As is typically assumed when modeling regional impacts of FWS operating and maintenance expenditures, our analysis assumes that a portion of this spending is directed outside of the local area. As a result, the local contribution is less than the initial amount expended, despite the multiplicative effects within the regional economy. Source: IEc IMPLAN analysis			

Summary of Regional Economic Impacts

Aspects of the ALNWR proposal will affect the regional economy in three measurable ways. The conclusions of IMPLAN analysis of these principal changes are described below:

- Reductions in agricultural output of vegetables, alfalfa and soybeans associated with acquisition of the Fairfield Marsh basin and the remainder of the Voluntary Acquisition Area may render annual losses in regional output ranging from approximately $3,186,000 to $4,360,000. This range represents approximately four to six percent of baseline output in these agricultural sectors (i.e., vegetables, hay and pasture, oil bearing crops, and feed grains) in Sauk and Columbia Counties. Similarly, estimated employment losses of 44 to 61 jobs per year represent two to three percent of baseline employment in these three agricultural sectors. Finally, losses in employee compensation may range from approximately $525,000 to $691,00 per year, or roughly nine to 12 percent of baseline compensation in the same sectors.

- Relative to total baseline output, employment, and compensation, losses associated with a change in farm output in all categories do not exceed nine *one-hundredths* of one percent.

- Recreation-related expenditures made by visitors to the ALNWR may contribute as much as $749,000 to $985,000 in output annually to the regional economy. Similarly, this infusion of spending may create 20 to 25 new jobs per year and add $195,000 to $260,000 per year in employee compensation.

- Finally, annual operating and maintenance expenditures may increase regional output by nearly $495,000 per year, create eight new jobs and contribute $148,000 per year in employee salaries.

- Thus, establishment of the ALNWR is likely to result in a net reduction in regional output of $1.7 to $3.1 million annually, depending on the development alternative pursued. This change is equivalent to four to seven *one-hundredths* of one percent of 1998 output in the region. In addition, when the refuge is complete, 11 to 33 jobs (two to five *one-hundredths* of one percent of 1998 employment) and $117,000 to $348,000 in employee compensation (one to three *one-hundredths* of one percent of 1998 salaries), which would have existed in agricultural industries, will not have been replaced by jobs and income generated by refuge activities.

There are several reasons why these results likely overstate the true regional economic impacts of the proposed ALNWR:

1) The results of our analysis reflect a static comparison of the regional economy with and without the refuge in its entirety. In reality, the refuge will be developed over the course of 20 years. Over this time period, workers and other productive resources displaced will be re-employed in other areas and/or sectors. These types of adjustments are not accounted for in our analysis. Similarly, regional output will increase over this time period, thereby reducing the relative magnitude of the impacts.

2) These estimates should be considered in the context of larger trends in Wisconsin agriculture which indicate declining employment and acreage.

3) These impacts will be mitigated by engineering and construction expenditures by the FWS during the 20-year development period. Specifically, as shown in Exhibit 5-6, in total, these expenditures will contribute over $6 million in output, 37 jobs and nearly $900,000 in employee compensation.

4) Finally, trends in recreational participation (wildlife observation in particular) suggest that visitation to the refuge upon completion may be greater than our own prediction based on current data, thereby

increasing the magnitude of expenditures and resultant contribution to the regional economy.

Given these mitigating factors, the net regional economic impacts arising from the ALNWR are unlikely to be perceptible at the county level.

TAX IMPLICATIONS OF THE ALNWR[5]

Should the FWS acquire lands in Sauk and Columbia Counties, local communities will forego tax revenues. In this section, we consider the probability of an increase in tax rates to compensate for these lost receipts. To estimate the potential tax implications, we tabulated the assessed value, including improvements, of lands within the proposed refuge area and provided this information to the Wisconsin Department of Revenue (DOR).[6] Because we are uncertain of the extent to which the FWS will acquire associated improvements within the refuge area, we consider the effects of: (1) removing land and all improvements from the tax base, and (2) removing land only from the tax base. Total tax impacts associated with the refuge proposal are likely to fall somewhere within this range.

The DOR maintains a model that performs property tax and state aid impact analyses of changes in tax revenues. The model accounts for state aid payments, such as those made by the FWS, in estimating the effect of a reduction in the tax base on a town, county and school district level. Under the Refuge Revenue Sharing Act of 1935, the FWS is required to make payments to counties or the lowest unit of government that collects and distributes property taxes. These payments are based on the largest of the following amounts: (1) $0.75 per refuge acre, (2) 25 percent of the net receipts collected from refuge lands in the county, (3) three-quarters of one percent of the appraised property value of the refuge.

Existing research suggests that the tax impacts of the proposed ALNWR acquisition are likely to be negligible. For example, a recent report by the DOR demonstrated that public lands have almost no effect on tax rates.[7] However, the results of the DOR preliminary analysis, presented in Exhibit 5-10, suggest that some impact may occur.

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[5] This discussion is presented for informational purposes. Since the regional economic modeling was based on gross output, costs of production, which include taxes, were already considered. Yet, changes in tax revenues are often of interest to local citizens.

[6] The full extent of parcels occurring on the proposed refuge border, with areas outside were included in the analysis. Thus, this estimate should represent an upper bound of potential tax implications.

[7] Refer to Huegel, Daniel P., "Public Land and Property Taxes," Wisconsin Department of Revenue, 1999.

Exhibit 5-10		
Property Tax Impacts of Proposed ALNWR		
	Change in Taxes on Average Home	
	Sauk County ($90,000)	**Columbia County ($75,000)**
Town	(Fairfield) $10.41 to $17.40	(Caledonia) $2.07 to $3.53
County	$0.40 to $0.63	$0.18 to $0.30
School District	-$1.44 to -$2.31	-$0.31 to -$0.36
Source: Analysis performed by Daniel Huegel and Monroe Rosner of the Wisconsin DOR, July 12, 1999.		

As these results suggest, the greatest impacts are likely to occur at the municipal level. The estimated changes in Fairfield tax payments range from 10 to 17 dollars, or six to 10 percent of the municipal taxes on an average residence. In Caledonia, changes in payments range from roughly two to four dollars, or one to two percent of taxes on an average home.[8] At the county level, changes in estimated tax payments for both areas are less than one dollar. Finally, the proposed ALNWR acquisition may result in a slight reduction in taxes administered at the school district level.[9]

It is important to note that much like our regional economic impact analysis, the DOR analysis reflects a static comparison of the tax base with and without the refuge. Given that these changes are likely to occur over a 20-year period, marginal reductions in tax revenues in each individual year are likely to be offset entirely by state and FWS compensation.

SUMMARY AND CONCLUSIONS

The results of our analysis of measurable changes in regional economic activity attributable to full implementation of ALNWR proposal alternatives indicate a net annual reduction in output equivalent to four to seven *one-hundredths* of one percent of baseline. Upon completion of the refuge in 20 years, a net annual loss of 11 to 33 jobs and $117,000 to $348,000 in employee compensation may occur. It is important to note that these results likely overstate the true economic impacts of the refuge for several reasons. Most importantly, our analysis is static in nature, and does not account for adjustments that would occur over the 20-year implementation period. In addition, negative economic

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[8] The average municipal taxes in Fairfield and Caledonia are $178.17 and $171.97, respectively.

[9] The state equalization aid formula "guarantees" a certain property value for each member (or full-time equivalent student). Should a disparity exist between a district's equalized value per member and the guaranteed value, state aid is increased to compensate. Thus, increases in the amount of public land in a district lower the equalized value per member and increase the degree of state aid. Nonetheless, the "equalizing formula" is sensitive to other factors such as the number of pupils and the magnitude of school district spending.

impacts would be further mitigated by FWS engineering and construction expenditures and resultant increases in regional output, employment and salaries.

It is also important to note that these results are sensitive to assumptions regarding agricultural prices and productivity. Specifically, we assume that the current characterization of agriculture in the region will adequately approximate future conditions. In addition, our estimates of economic gains associated with the ALNWR proposal are based, in part, on assumptions regarding the magnitude of new visitation and spending in the region. Nonetheless, we feel that these estimates are conservative (i.e., low). Finally, a decrease in local tax revenue may affect individual property owners' tax burden in a very minor way, although appreciable effects are unlikely.

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